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EDITED BY

REV. J. L. ZABRISKIE,

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New-York Microscopical Society.

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Regular Meetings on the first and third Fridays of each month, from October to June, inclusive, at 8 P. M., at No. 64 Madison Avenue.

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VOL. VII. OCTOBER, 1891. No. 4.

STRUCTURE IN STEEL.

BY P. H. DUDLEY.

(*Read June 19th*, 1891.)

The subject is so vast and important that I shall confine my remarks principally to rail steel. Besides the iron forming the basis of ordinary steel rails, they have a large range in chemical composition, as shown by the following table:

	Parts of 1 per cent.
Carbon	.25 to .50
Manganese	.30 to 1.50
Silicon	.04 to .30
Phosphorus	.03 to .15
Sulphur	.04 to .10
Copper	.10 to .80

Traces of other minerals are present.

This alloy, being formed by fusion and cast, is of course crystalline in structure. The texture will be fine or coarse, according to composition, size of ingot, rapidity of solidification, amount of mechanical work given to the metal in reducing to the section of the rail, shape and size of the latter, and the temperature at which the rail is finished. In a section of rail of which the ingot or bloom was maintained at too high temperature, the crystallization becomes coarse and often sharply defined, the matrix enclosing or joining the crystals weak and breaks upon the surface, instead of pulling out the portions which penetrated the large pseudo-crystals. The delicate matrix enclosing the pseudo-crystals is shown in specimen No. 1 with low powers, but few

traces of lines from the matrix are seen to penetrate to the interior of the polygons. This specimen is from the tire of a steel wheel, is very hard, and contains 6 per cent of manganese. Wheels of such steel have given a very large mileage. Specimen No. 2 is from a rejected heat of rails, and contains .90 of carbon. The ingot was maintained at too high a heat in the reheating furnace, coarse crystals resulting in the head of the rail, and, as will be seen, they are quite well defined. In the fracture the crystals have separated from each other through the matrix without breaking the individual crystals. This shows first the overheating of the steel, which, in a large head of a rail, does not receive sufficient work to break up this coarse crystallization. The distance across the axis of the crystals measures $\frac{150}{1000}$ to $\frac{175}{1000}$ of an inch, which, for a good wearing rail, I consider coarse, though the majority of rails in the track are much coarser. Specimen No. 3 is from the same rail, taken near the top of the head, and shows that the mechanical treatment of rolling has broken up the coarse crystallization, rendering it practically amorphous, very fine in texture—in fact, much finer than can be expected in rails until higher carbons are reached than has been until recently considered advisable to put in the tracks. As we increase the carbon in rails we increase the hardness, raise the elastic limit and tensile strength, but, on the other hand, decrease the elongation, and, without great care, render the steel brittle under shock instead of retaining sufficient toughness in the rails to render them safe in the track during winter in this latitude. The element phosphorus tends to render rails brittle, or cold-short, and as the carbon is increased the phosphorus must be decreased, at least with ordinary sections having deep heads and thin bases. Phosphorus exists in the pig iron, or the ores from which the pig iron is made, and to such an extent in many ores that they are unsuitable for Bessemer metal, and it requires some care to select ores which will run from .08 to .10 of 1 per cent of phosphorus, about the limit to be combined with .35 to .40 of 1 per cent of carbon. While rails, many years since, containing .35 to .40 in carbon were suitable for the traffic at that time, they wear too rapidly under the present traffic. To increase the carbon for better wearing qualities, it is first necessary to introduce a section for heavy rails which would cool more uniformly, reducing the coarseness

of the texture, and at the same time keep the phosphorus down to avoid brittleness.

In 1883 I designed an 80-pound section, which makes the structure of the metal in the head much finer than usual. The section was put into service in 1884, the manufacture of which became the type of modern sections. Over 200,000 tons of this section have been put into service, some of the rails having .50 in carbon. Even with so much carbon the elastic limits of the steel are below what is necessary for modern traffic, and I am now making rails with .60 carbon, the phosphorus being down to or under .06. Specimen No. 4 shows a piece of steel from such a composition which is very fine-grained for a large rail, tough, and has a tensile strength of 120,000 to 130,000 in the head, the elastic limits ranging from 60,000 to 65,000 pounds. Such rails can be produced commercially, the cost only being increased about one-tenth above the cost of ordinary rails.

Without microscopic examination it is difficult to see why it is so important to make the rails of fine texture and high elastic limits. If a rail simply had to perform the functions of a girder, we could increase its dimensions so that it would have ample strength, even though the elastic limits of the metal were low. But the upper surface of the rail must also act as the infinitesimal rack by which the drivers secure their adhesion for locomotion. Tracing these matters out more fully, we find the metal, in the head of the rail under a driver, in *compression* to the vertical axis of the section, while the metal under the neutral axis would be in *extension*, which would reach to each tie, beyond which, as far as affected by the weight of that driver, the base would be in compression and the head in extension. These strains would be reversed as the driver or wheel reached the next tie space. The metal in the head directly under the wheel must not only bear the weight upon the driver, but also all the traction the driver is exerting to draw the train. From the small areas in contact, the ratio of pressure is from 60,000 to 80,000 pounds per square inch, while the traction often amounts to one-half as much for the surfaces in contact as longitudinal strain upon a thin layer of surface metal in the rail head. Examining the rails in the track with the microscope, we find not only small portions of the metal torn out, but a series of minute cracks, showing that

the metal has been strained upon the surface beyond its elastic limits, and surface wear of metal rapidly occurs. To check this wear we need high elastic limits of the metal for the surfaces in contact. The metal in the tires of wheels abrades on the surface and also drops out in patches, as may be seen in specimens Nos. 3 and 4.

It will be readily understood that, while it is desirable to have sufficiently high elastic limits in the steel to keep the section from taking permanent set under the loads or trains, it is necessary to have high elastic limits in the metal to resist wear. Steel of .35 to .40 carbon has elastic limits in the head varying from 38,000 to 45,000 pounds per square inch, and even then, in the thin-flanged rails, is liable to be brittle. In steel like that shown in specimen No. 4 the elastic limits range from 60,000 to 65,000 pounds in the head, and it is tough in the sections in which it is used. In the 75-pound section, into which several thousand tons have been rolled, the rails are exceptionally tough, exceeding, so far as any records have been published, any tests which have been made. In the 95-pound rails, into which many thousand tons of high carbon metal have been rolled, they are much tougher than was supposed possible to make such large sections. The tendency of improvement in quality of steel is now the production of a fine texture having high elastic limits and considerable percentage of elongation before the full limit of tensile strength is reached. Specimen No. 5 shows the end of a tensile specimen of 53,470 pounds elastic limit and 23 per cent of elongation, the fracture fine and silky, showing at once that it was a tough piece of metal. No evidence of coarse crystallization on the interior of the specimen is to be seen, portions of the matrix penetrating and pulling out from the interior of all the crystals. This steel has been worked to make a fine texture. Specimen No. 6 is from the side of specimen No. 5, and shows on the exterior a tendency to separation on the outside surface of the original large crystals as soon as the steel has passed the elastic limits. On the interior, each crystal being surrounded, greater flow or distortion takes place before separation. This specimen will also serve to better illustrate my remarks about the necessity of high elastic limits in surface of the rails to resist wear.

PROCEEDINGS.

Meeting of April 3d, 1891.

The President, Mr. P. H. Dudley, in the chair.

Twenty-one persons present.

Mr. A. Woodward, chairman of the Committee on Annual Reception, reported the action of the Committee, and the favorable response of the members of the Society, indicating the prospects of a successful Reception.

On motion it was resolved : That the Committee on Annual Reception invite dealers to exhibit instruments and apparatus at said Reception.

Mr. Stephen Helm, F.R.M.S., delivered the fourth and last of his series of addresses on the lower forms of animal life, entitled "Polyzoa and Hydrozoa." This address was illustrated by an extended succession of beautiful, enlarged diagrams, prepared by Mr. Helm, and also by objects exhibited under microscopes as stated below.

objects exhibited.

1. *Hydra viridis :* by Stephen Helm.
2. Statoblasts of *Pectinatella magnifica :* by Stephen Helm.
3. *Plumatella repens :* by Stephen Helm.
4. *Bugula avicularia* with "bird's-head processes" : by Edw. G. Love.
5. *Bicellaria tuba :* by Edw. G. Love.

On motion the thanks of the Society were tendered Mr. Helm for his series of interesting addresses.

Annual Reception.

The Annual Reception of the Society was held at the American Museum of Natural History, Central Park, New York City, on the evening of April 17th, 1891.

The exhibits were displayed in the large Hall of the first floor of the Museum.

In the large new Lecture Room, adjoining, three successive exhibitions were given as follows : At 8 p.m., Exhibition of Lantern Slides of Diatoms, by Charles F. Cox; at 9 p.m., Ex-

hibition of Lantern Slides of Photomicrographs, by Edw. G. Love; at 10 P.M., Exhibition of a series of Wood Sections, by P. H. Dudley.

The projections of these exhibitions were made on two screens by two stereopticons alternately, one illuminated by the electric arc light, under the care of L. H. Laudy, and the other illuminated by the lime light, under the care of L. C. Laudy.

The intervals between the exhibitions were enlivened by excellent band music.

The microscopical objects in the large Hall and their exhibitors are herewith enumerated as follows:

OBJECTS EXHIBITED.

1. (In alcove.) Old Microscopes and Objectives: by Wm. Wales, J. L. Zabriskie, C. F. Cox, D. S. Martin, and F. D. Skeel.

2. Prints of Old Microscopes: by E. G. Love.

3. (In alcove.) Photomicrographic Apparatus: by L. H. Laudy.

4. (In alcove.) Section Cutting, illustrated by Apparatus and a selection of Serial Sections, prepared by the Paraffin Process: by L. Riederer.

5. (In alcove.) Bacteriology, illustrated by growing cultures and slides: by C. E. Pellew.

Photomicrography: by E. G. Love—

6. (In alcove.) Apparatus and the method of its use.

7. Prints of various forms of Photomicrographic Apparatus.

8. Photomicrographs, and the same with Negatives.

9. (In alcove.) Case, showing specimens of Termites, their destructive work, and portions of their nests: by P. H. Dudley.

10. (In alcove.) Case, showing specimens of Fungi and Decayed Wood: by P. H. Dudley.

11. (In alcove.) A Series of Drawings of the lower forms of Animal Life: by Stephen Helm.

12. (In alcove.) Microphotography, illustrated by Apparatus and Slides: by S. N. Ayres.

13. Attachment to the Turn-Table, with mechanism for driving the same: by F. D. Skeel.

Instantaneous Photomicrographs: by J. M. STEDMAN—

14. Colony of Vorticellidæ, from life.

15. Group of Nais in rapid motion.

Foraminifera: by A. WOODWARD—

16. *Haliphysema Tumanowiczii*, Cornwall, Eng.

17. *Faujasinao carinata*, Cornwall, Eng.

18. Specimens from Chalk, Island of Rügen.

19. Specimens from all parts of the world, and a selection from the collection of the American Museum of Natural History.

20–21. Two Slides, mounted by J. W. Bailey about 1845.

22. Human Flea, *Pulex irritans:* by WM. BEUTENMÜLLER.

23. Eye of House Fly, *Musca domestica:* by WM. BEUTENMÜLLER.

24. Sting of Honey-Bee, *Apis mellifica:* by WM. BEUTENMÜLLER.

25. Scales of various Species of Butterflies, with a collection of Butterflies and Moths from the American Museum of Natural History: by WM. BEUTENMÜLLER.

26. Alloy of Gold, Silver, and Copper: by L. P. GRATACAP.

27. Section of Tulip-Tree, *Liriodendron tulipifera:* by L. P. GRATACAP.

28. Crystals of Sulphate of Copper: by ALFRED BEUTENMÜLLER.

29. Crystals of Bichromate of Potassium: by ALFRED BEUTENMÜLLER.

30. Crystals of Chlorate of Potassium: by ALFRED BEUTENMÜLLER.

31. Vinegar Eels, living: by ALFRED BEUTENMÜLLER.

32. Agatized Wood, enclosing Fungus, Arizona: by THOS. B. BRIGGS.

33. Basalt with Olivine: by THOS. B. BRIGGS.

34. Oligoclase, New York City: by THOS. B. BRIGGS.

35. Hornblende, New York City: by THOS. B. BRIGGS.

36. Foot of Fly: by THOS. B. BRIGGS.

37. Section of Pebble from Chagres River, Panama: by THOS. B. BRIGGS.

38. Sections of Epidosyte, Fibrous Hornblende, Tourmaline, Oligoclase, Mica-schist, and Mica, shown with automatic revolving stage: by JAMES WALKER.

39. Sections of Garter-Snake, embryo, *Eutania sirtalis:* by L. RIEDERER.

40. Sections of California Salmon, embryo, *Oncorhynchus chouicha:* by L. RIEDERER.

41. Marine Crustaceans: by L. RIEDERER.

42. Sections of the Eyes on the Mantle of the Common Scallop, *Pecten irradians:* by L. RIEDERER.

43. Sections of the Eye of the Hermit Crab, *Eupagurus Bernhardus:* by L. RIEDERER.

44. Larval English Oysters, polarized light: by SAMUEL LOCKWOOD.

45. Metal Chips cut from Cover of Box by Mexican Beetle: by F. W. DEVOE.

46. Spider's Silk Compared with 120 Spool-Cotton Thread: by F. W. DEVOE.

47. Section of a Rat's Toe: by CHAS. S. SHULTZ.

48. Platino-cyanide of Magnesium, polarized light: by CHAS. S. SHULTZ.

49. Vase and Bouquet of Diatoms and Butterfly Scales: by MISS M. A. BOOTH.

50. Section of Leaf of Scotch Pine, *Pinus sylvestris:* by GEO. E. ASHBY.

51. Fibre from Fruit-stalk of Banana, polarized light: by E. G. LOVE.

52. Anchors and Plates of Synapta, dark-ground illumination: by E. G. LOVE.

53. Crystallized Tin: by E. G. LOVE.

54. Spiracle of Larva of Dytiscus: by E. G. LOVE.

55. Itch Insect, *Sarcoptes scabiei:* by E. G. LOVE.

56. Gizzard of Cricket: by E. G. LOVE.

57. Arrowhairs of Dermestes: by E. G. LOVE.

58. Luxulyanite, polarized light: by J. W. FRECKELTON.

59. Native Copper, crystallized, Lake Superior: by FREDERICK KATO.

60. Crystals of Black Snake Fat, polarized light: by EDGAR J. WRIGHT.

61. Bacillaria paradoxa, living: by A. G. ROBINSON.

62. Hydra viridis: by T. CRAIG.

63. Section of Echinus Spine and Echinus with Spines removed: by A. H. EHRMAN.

64. The Parasitic Wasp, *Leucospis affinis* Say: by J. L. ZABRISKIE.

65. Fragment of "The Pen" of the Squid, *Loligo Pealei* Lesueur, polarized light: by J. L. ZABRISKIE.

66. Tangential Section of Bamboo: by F. D. SKEEL.

67. Section of Gneiss, Long Island, polarized light: by F. D. SKEEL.

68. Compound Eye of Insect, with multiple images: by J. D. HYATT.

Termites, or so-called "White Ants," from Panama: by P. H. DUDLEY—

69. Eutermes Soldier—entire.

70. Head of Termes—Soldier.

71. Head of Calotermes—Soldier.

72. Worker of Termes minimus Beaumont.

73. Head and Wing of Termes minimus Beaumont.

74. Ovaries, portion, of Eutermes Queen.

75. Circulation of Chlorophyll in Nitella, a fresh-water plant: by STEPHEN HELM.

76. Pond Life: by STEPHEN HELM.

77. Diatom, *Arachnoidiscus Ehrenbergii:* by F. COLLINGWOOD.

78. Cyclosis in Cells of Anacharis Canadensis: by C. F. COX.

79. Section of Serjania (stem), polarized light: by C. F. COX.

80. Section of Skin from Negro, showing pigment cells: by W. H. MEAD.

81. Pond Life: by M. M. LE BRUN.

82. Circulation of Blood in the Foot of the Frog: by JNO. L. WALL.

83. Gold Crystals, Fern-leaf form: by G. S. WOOLMAN.

84. Section of Wood: by G. S. WOOLMAN.

85. Head of Mosquito: by G. S. WOOLMAN.

86. Silver Crystals in process of deposition from Nitrate of Silver: by GEO. C. F. HAAS.

87. Human Blood on Holman's Slide: by F. W. LEGGETT.

88. Pollen of Lavatera, in situ: by H. W. CALEF.

Microphotographs: by S. N. AYRES—

89. Sherman's March to the Sea.

90. Foes or Friends.

91. Portrait of Lady.

92. Portrait of Child.

93. Butterfly Scales (1173) arranged to represent a Vase of Flowers: by C. W. McAllister.

94. Scales of forty varieties of South American Lepidoptera: by J. D. Mallonee.

95. Human Scalp, vertical section showing hair bulbs and sebaceous glands: by H. F. Crosby.

96. Foot of Emerald Spider, *Micromata smaragdula*, by H. Hensoldt.

97. Feathers of Brazilian Humming-bird: by H. Hensoldt.

98. Section of Human Brain: by S. A. Briggs.

99. Daphnia pulex: by O. S. Wilson.

100. Chelifer, Pseudo-scorpion: by Wm. Huckel.

101. Tongue of Honey-bee: by C. W. Brown.

102. Leg and Foot of Honey-bee, showing pollen brushes and pollen in situ: by H. C. Bennett.

103. Human Optic Nerve: by L. Schöney.

104. Phylloxera of Grape Vine: by L. Schöney.

105. Yeast Plant: by A. S. Hunter.

An extended series of Microscopes and Microscopical Apparatus was also exhibited by Meyrowitz Brothers, George S. Woolman, Bausch & Lomb, and Eimer & Amend.

It was estimated that between two and three thousand persons were present during the evening.

Meeting of May 1st, 1891.

The Vice-President, Mr. J. D. Hyatt, in the chair.

Fourteen persons present.

Mr. Sereno N. Ayres was elected a Resident Member.

The Corresponding Secretary announced the donation to the Cabinet of the Society by Miss M. A. Booth of 13 slides of her own preparation—1. Flea of Mouse; 2. Parasite of Barred Owl; 3. Jigger Flea from Florida; 4. Parasite of Snipe; 5. Parasite of Snowy Owl; 6. Flea of Cat; 7. Parasite of Pig; 8. Hairs of larva of *Trogoderma ornata;* 9. Parasite, eggs of parasite, and

hairs of Monkey; 10. Wing of Mosquito, *Anopheles quadrimaculata;* 11. Spicules of Sponge, *Meyenia fluviatilis;* 12. Statoblasts of *Plumatella;* 13. Epidermal organs of *Mentzelia floridanum.*

In addition to the above Miss Booth also donated three photomicrographs, taken by herself—1. Statoblasts of *Plumatella;* 2. Hairs of *Trogoderma ornata;* 3. Hairs of *Anthrenus scrophulariæ.*

On motion the thanks of the Society were tendered Miss Booth for these donations.

The Recording Secretary, Mr. Geo. E. Ashby, announced the receipt, from the Department of Microscopy of the Brooklyn Institute, of tickets of admission and the invitation of the members of this Society to attend the Annual Reception of said Department of Microscopy, to be held in Brooklyn on the evening of the 13th instant.

On motion the thanks of the Society were tendered the Department of Microscopy for this invitation.

Mr. E. A. Schultze announced the intended visit to this country in the approaching fall of Mr. J. D. Möller, of Holstein. During this visit Mr. Möller will exhibit large collections of his celebrated preparations of diatoms. Mr. Schultze referred at length to the famed work of the eminent preparer, and distributed among the members of the Society Mr. Möller's circulars, giving the history and description of his famous type and test-slides.

On motion of Mr. Schultze it was resolved: That the Board of Managers be requested to extend an invitation to Mr. Möller to meet this Society during his proposed visit to this country, at some time agreeable to his own convenience.

On motion it was resolved: That the thanks of the Society be tendered Mr. Morris K. Jesup, President, and the members of the Board of Trustees of the American Museum of Natural History, for the generous manner in which the Halls of the Museum and all accompanying facilities were accorded the Society on the occasion of the late Annual Reception.

On motion it was resolved: That the thanks of the Society be tendered Dr. L. H. Laudy and Mr. L. C. Laudy for their invaluable assistance in the provision and the management of the stereopticon projections; and to Mr. William Wallace, Superintendent of the Museum, for the courteous manner in which

he had assisted the Committee on this same occasion of the Annual Reception.

On motion it was resolved: That the Curator be requested to furnish the Recording Secretary, at intervals, with a list of suitable objects in the Cabinet of the Society, from which selections of exhibits for the regular meetings of the Society may be made when it may be desirable.

The Chairman, Mr. J. D. HYATT, announced the approaching meeting of the American Society of Microscopists, to be held in the city of Washington on the 11th of August.

OBJECTS EXHIBITED.

1. Jigger Flea from Florida—Donation to the Cabinet and preparation of Miss M. A. Booth: by J. L. ZABRISKIE.
2. Statoblasts of *Plumatella:* by J. D. HYATT.
3. Conjugation of *Spirogyra nitida:* by E. G. LOVE.
4. Photomicrograph of the same: by E. G. LOVE.
5. Wing of Mosquito from Panama: by T. B. BRIGGS.
6. Section of Hornblende: by T. B. BRIGGS.
7. Epidermal organs of *Mentzelia floridanum:* by G. E. ASHBY.
8. The cœlenterate, *Obelia commissuralis:* by L. RIEDERER.
9. *Bugula* sp. with diatoms in situ: by L. RIEDERER.

MEETING OF MAY 15TH, 1891.

The Vice-President, Mr. J. D. Hyatt, in the chair.

Thirteen persons present.

The Corresponding Secretary announced a communication from Mr. K. M. Cunningham, of Montgomery, Alabama, accompanying a donation to the Society of a packet of infusorial earth, an extended deposit of which earth Mr. Cunningham had lately discovered in the neighborhood of Montgomery. The main portion of the communication consisted of the following article, relating to this subject, published by Mr. Cunningham in a late issue of the Montgomery *Advertiser:*

"*Discovery of a New Infusorial Earth at Montgomery.*

Editor Advertiser:

"As a matter of scientific interest to your readers, I would like to make known the discovery of a deposit of infusorial earth,

made on yesterday evening while strolling along the river bluffs, observing the character of the various exposed strata. While in the vicinity of the soap factory I noticed an outcrop of argillaceous earth, which, upon an ocular examination with a small lens, suggested the possibility of its being a fossil earth. On giving it the requisite treatment, I was surprised to find that it proved to be a pure diatomaceous earth, and as it happens to be the first of its kind and character recorded as occurring in the Southern States, I hasten to announce the fact. To convey a popular idea of what the substance is in an economic way, it has the following uses in the industrial arts: under the common name of tripoli it is used in polishing optical lenses of all kinds; next, as the basis of the well-known dentifrice Sozodont; then as an adjunct to nitroglycerin in making the powerful explosive called dynamite; as a silverware polishing substance known in the trade as electro-silicon; and, finally, as of universal interest as material for microscopic study and research, its value as a microscopic novelty being about one dollar a pound. Incidental to the above points of interest, I would mention that its occurrence adds another component rock to the geological strata of Alabama, hitherto not noticed or mentioned in any work treating of the geology of Alabama. I have barely examined the extent of the thickness of the stratum, but it may have a greater thickness than four feet, and may likewise underlie a very wide area in the vicinity of the hill where its outcrop occurs. A substance similar in its nature and composition occurs in Northern Europe, and is known as 'mountain meal,' and in times of scarcity of food is mixed with wheat or rye and eaten as food. The mineralogical characteristics of the substance are in its being a white clay-like substance, fissile, lamellar; when moistened gives off a clay-like odor and adheres to the tongue; dissolves readily in the mouth, and is pleasant and agreeable to the taste; its mineral composition is practically pure silica; in its microscopic appearance it is a flour composed of millions of minute and very elaborately sculptured silicious, glassy, or transparent shells, associated also with numerous fresh-water sponge spicules, and the absence of all other extraneous vegetable and mineral débris, such as sand grains, etc. The numerous included species are similar to forms already named from localities in the New England States, but an entirely new

source of the material must in the future make Montgomery widely known, as diatomists in all parts of the world will want samples of it for their collections when its fame is spread abroad.

"Dr. Wilkerson, of this city, is the first person who has been able to verify this discovery, as it was first viewed through the microscope in his office. K. M. CUNNINGHAM."

OBJECTS EXHIBITED.

1. Eggs of Bot-fly on horse-hair: by H. W. CALEF.

2. A curious unknown, aquatic, hemipterous larva: by J. L. ZABRISKIE.

3. A bar of Flexible Sandstone from South Carolina: by WILLIAM G. DE WITT.

From the Society's Cabinet:

4. Parasite of Barred Owl.

5. Hairs of larva of *Trogoderma ornata*.

6. Wing of Mosquito, *Anopheles quadrimaculata*.

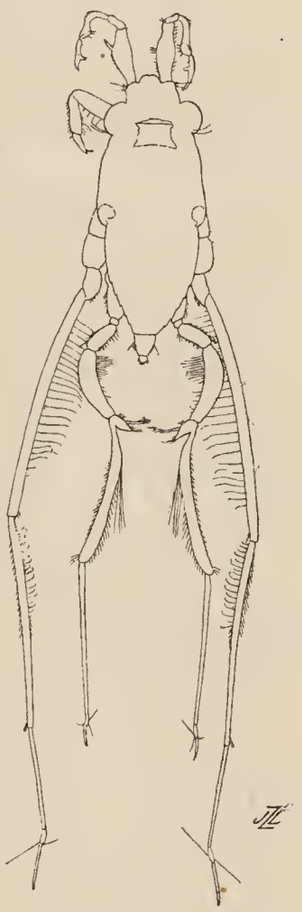
7. Spicules of Sponge, *Myenia fluviatilis*.

8. Parasite, eggs of parasite, and hairs of Monkey.

Mr. De Witt donated his exhibit of Flexible Sandstone to the Cabinet of the Society.

Mr. Zabriskie said of his exhibit that it was captured on July 11th, 1890, in the stream of the Water Works, Flatbush, Long Island. It was at first supposed to be a young larval form of *Gerris;* but it is much more strange in general contour and in curious additions to the appendages than any observed form of *Gerris*. The color is a uniform black, excepting five whitish spots, visible from above—one on the prothorax, two on the outer posterior margins of the metathorax, and two including the posterior coxæ. It has large, four-jointed palpi, the first proximal joint and the fourth joint bearing prongs, giving the appearance of stag horns. When a palpus is deflected the prong of the first joint apparently enters a cavity near the distal end of the third joint, probably forming a prehensile organ. The beak is short, stout, and reclined upon the sternum. The eyes are large and globular. The anterior legs are short and robust. The middle legs are much the longest, being equal to about two and one-half times the entire length of the body from the vertex to the anus. The femur of each middle leg is furnished throughout nearly its entire length with a row of straight, prominent

hairs, about twenty-four in number, averaging in length about twice the diameter of the femur, projecting backward at right angles with the axis of the femur, each hair being slightly hooked at its distal extremity. The tibia of each middle leg is furnished with a row of about sixteen hairs, somewhat resembling those of the femur, excepting that they are shorter, more curved, more prominently hooked, and in that they extend only about one-half the length of the tibia, beginning at the proximal end. The femora of the posterior legs are so curved inwardly that, when opposed to each other, they form a nearly completed circle, and are each furnished with a tuft of stout hairs on their inner opposed surfaces. The tibiæ of the posterior legs are each furnished at the proximal end with a stout projection, turned at an angle inwardly, like the barb of a fish-hook, and each barb is surmounted by a stout, flexuous spine. These tibiæ have also each a slender pencil of long hairs about midway on their inner surfaces, and projecting backward at an acute angle with these surfaces. The last joint but one of the tarsi of the middle legs is furnished with two, and the corresponding joint of the posterior legs is furnished with three, long, diverging bristles. The entire length of the larva, from the curve of the deflexed palpi to the extremities of the long middle legs, when these latter are projected backward, is about three-eighths of an inch, and the length of the body from vertex to anus is a little less than one-eighth of an inch.



Unknown aquatic larva. Magnified 10 diameters.

Meeting of June 5th, 1891.

The Vice-President, Mr. J. D. Hyatt, in the chair.

Eighteen persons present.

The Corresponding Secretary announced the death of Mr. Charles W. Brown, a Resident Member of the Society.

On motion it was resolved: That this Society has received with sorrow the intelligence of the death of one of its members, Mr. Charles W. Brown, of this city, whose demise occurred on May 19th last, and hereby records this expression of its loss sustained under this unexpected removal of an interested, sympathetic, and faithful attendant at its sessions.

The Corresponding Secretary announced a communication from Mr. K. M. Cunningham, of Mobile, Alabama, dated May 27th, 1891, and accompanying a donation to the Society of a hand-moulded brick of diatom-bearing clay weighing five pounds, which Mr. Cunningham had secured at Apalachicola, Florida, while on a Government survey of the bay, at a point on the bay shore about two miles south from the steamboat wharf at Apalachicola. Mr. Cunningham stated that "the material, on proper treatment, will yield a very interesting showing of 'Gulf Marine Diatoms.'" This "brick" was exceedingly hard, and only after severe labor with a cold-chisel and a heavy hammer were fragments secured, which were distributed among the members of the Society.

The Corresponding Secretary also read a second communication from Mr. Cunningham, dated May 29th, 1891, describing additional donations from him, as follows:

"1. A packet of Foraminifera from rotten limestone, Selma, Alabama. This rock underlies a wide area in the Black Belt, and outcrops at Selma as a bluff fifty feet high and of indefinite length on the river side. If a specimen of this substance be abraded with a tooth-brush, millions of the crystalline microscopic shells are secured.

"2. A piece of the rotten limestone having two sides prepared and polished so as to show the transparent nature of the microscopic shells.

"3. A packet of diatoms from a great spring near Birmingham, Alabama. The diatoms are related to *Epithemia* and *Eunotia*, and are so coarse that they move as freely in the packet as dry sand. They occur *in situ* or parasitic upon a sphagnum moss which grows on the rocky sides of the spring, from the surface down to fifty feet in depth, and are found in long ribbon-like masses, which, under acid treatment, break up into singles, doubles, etc. When the moss is dry a little shaking causes them to fall off, when they can be secured, if desired, by the pint.

"4. A packet of sand from the chert quarries near Birmingham, mainly composed of fragments of silicious, spicular bodies, and curious as a polariscope object.

"5. A packet of microscopic coral from a ledge on the Chattahoochee River at Fort Gaines, Georgia. The ledge is of enormous thickness and extent. The specimens were obtained by sifting the chalky material through gauze.

"6. A packet of fossil granules from a stratum of iron ore, excavated from the tunnel through the Red Mountain. The specimen suggests waste coffee grounds. It is not pretty, but contains a few microscopic snail-like shells.

"7. Fulgorite from a white sand bank at Apalachicola Bay Beach, Florida. If thin fragments of the cylinders are examined, the interior will be seen to be vitrified and polished, and, being full of gaseous bubbles (air?), will show tension colors as a polariscope mount.

"8. My attention having been drawn to certain blister-like blemishes in the oyster shells at Apalachicola, Florida, a brief examination showed that invariably under each blister a small quantity of mud was sealed. Where the inside of the blister did not touch the mud a great array of oyster-shell pearl particles were strewn. Only one side of the blister presents the phenomenon, and it forms an interesting object for the binocular.

"9. Two smoothed fragments of a colossal vertebral joint from the cretaceous formation of Alabama. These specimens, probably from the vertebra of *Zeuglodon*, are curious as being fossil bone. Two of these joints superposed are as large as a month-old baby."

OBJECTS EXHIBITED.

1. Arranged slide of 275 Diatoms from the Sendai deposit, Japan, prepared by Rev. Albert Mann, Jr.: by E. A. SCHULTZE.

2. Section of wood of Hemlock, *Tsuga canadensis* Carr., polarized: by E. G. LOVE.

3. Photomicrograph of *Pleurosigma angulatum*, taken by Dr. Clifford Mercer with a dry $\frac{1}{8}$, air angle 1.40, to show progress made in the manufacture of lenses: by WILLIAM WALES.

4. Larvæ of *Gerris*, of different ages: by J. L. ZABRISKIE.

5. Unknown larva of a Cecidomiid Fly, mining the leaves of the Red Cedar, *Juniperus virginiana* L.: by J. L. ZABRISKIE.

6. Section of eye of King Crab : by JAMES WALKER.

Mr. Zabriskie said of his exhibits that these larvæ of *Gerris* are of different sizes and doubtless of different ages, some of them being much smaller and all of them much plainer creatures than the remarkable aquatic larva exhibited at the last meeting.

The larva of the fly mining the leaves of the Red Cedar was taken at Cypress Hills, Long Island, on April 25th last, and was found only on this one occasion. The larva mines the base of the leaf—usually the tenth or twelfth leaf from the tip of the twig—causing an orange-colored, gall-like swelling. The mines are usually scattered and solitary. Only in two instances were larvæ found at the bases of adjoining leaves. The larva is of a bright orange color, about one-sixteenth of an inch long, stout, head very small, and with the junctions of the abdominal rings much constricted. Twenty-two specimens were found upon one small branch of the tree. The larva was submitted to Dr. Charles V. Riley, Entomologist-in-Chief, Washington, and he reported it as "new to the National Collection."

MEETING OF JUNE 19TH, 1891.

In the absence of the President and the Vice-President, Mr. Anthony Woodward was elected chairman.

Sixteen persons present.

Mr. Ernest Du Vivier was elected a Resident Member.

Mr. George E. Ashby was elected Recording Secretary in place of Dr. Bashford Dean, who was compelled to resign the office on account of the pressure of other duties.

The Recording Secretary read a paper by the President, Mr. P. H. Dudley, entitled "Structure in Steel." This paper was illustrated by six exhibits, as noted below, and is published in this number of the JOURNAL, p. 115.

OBJECTS EXHIBITED.

Six specimens of Rail Steel : by P. H. DUDLEY.

1. From the tire of a steel wheel ; very hard ; containing 6% of manganese, and showing the delicate matrix enclosing the pseudo-crystals. Wheels of such steel have given a very large mileage.

2. From a rejected heat of rails. The ingot was maintained at too high a heat in the reheating furnace. Coarse crystals resulted in the head of the rail. In the fracture the crystals have separated from each other without breaking the individual crystals.

3. From the same rail as No. 2, taken near the top of the head. The specimen shows the effect of the mechanical treatment of rolling, which has broken the coarser crystallization, rendering it of very fine texture—practically amorphous.

4. From a fine-grained large rail having a tensile strength of 120,000 to 130,000 in the head, the elastic limits ranging from 60,000 to 65,000 pounds. The specimen contains 60% of carbon, the phosphorus being down to or under .06.

5. The end of a tensile specimen of 53,470 pounds elastic limit and 23% of elongation. The fracture is fine and silky, showing that it was a tough piece of metal. This steel has been worked to a fine texture.

6. From the side of No. 5, showing on the exterior a tendency to separation on the surface of the original large crystals as soon as the steel has passed the elastic limits.

7. Section of ovary of Poppy: by CHARLES S. SHULTZ.

8. Section of English Mistletoe, double stained: by CHARLES S. SHULTZ.

9. Section of scalariform ducts in Tree-fern: by CHARLES S. SHULTZ.

10. Native gold crystals from Catawba Co., North Carolina; by GEORGE E. ASHBY.

11. Malachite from Arizona: by GEORGE E. ASHBY.

12. Section of Luxullianite from Cornwall, England: by JAMES WALKER.

13. Head and mouth parts of *Neris*: by L. RIEDERER.

14. Down feather of Canary Bird: by L. RIEDERER.

15. Transverse section of bud of Lily, of the thickness of one cell of the structure, double stained, having all parts *in situ*, and showing nuclei in all the cells: by ALBERT MANN, JR.

16. Transverse section of the ovipositor of the "Long-Sting Wasp," *Thalessa atrata* Fab.: by J. L. ZABRISKIE.

17. A specimen of *T. atrata*, captured in the act of ovipositing, and having the ovipositing membrane still distended five-eighths of an inch in diameter by the internal coils of the bases of both

the ovipositor proper and the guiding sheaths: by J. L. Zabriskie.

Referring to his exhibits, Mr. Zabriskie said that the ovipositor proper of *Thalessa* corresponds with that of *Cryptus* and all its near relatives (see Mr. Riederer's drawings, this Journal, vol. vi., Plate 25), being composed of three main pieces firmly interlocked, but sliding upon each other throughout their entire length. The dorsal piece is the largest. It is solid at the back, nearly cleft in twain from beneath, allowing elastic expansion as of a spring hinge, and having a "tongue" at the middle of either side of the base. The two ventral pieces are counterparts of each other, each being provided with a groove for interlocking with and sliding upon the respective tongues of the ventral piece.

The best published account extant of the oviposition by *Thalessa* is that by Dr. Charles V. Riley in *Insect Life*, i., 172. He shows that the operation is somewhat as follows: The insect stands high upon its feet. The abdomen is raised in the air at right angles with the thorax. The ovipositor, five inches long, more or less, is managed by some of the feet, and its point is brought to bear upon the wood of the tree. The halves of the sheath do not enter the wood with the ovipositor proper, but are used as props and stays for the boring tool during the operation. By a movement from side to side and by bearing upon the ovipositor, the insect gradually forces back the base of the ovipositor proper through the tip of the abdomen into a membrane which issues between the sixth and seventh joints dorsally. There is a wonderful muscular power in the anal joints, and the ovipositor is forced back until it forms a perfect coil, so that, when the abdomen is stretched in a straight line to its utmost, the ovipositor within the membrane makes a circle almost as large as a quarter of a dollar, the anal joint having made a three-fourths turn within the membrane. During this operation the halves of the sheath, which have not followed the ovipositor within the membrane, have been obliged to make a more or less irregular coil opposite to and in front of the membrane on the ventral side. As the ovipositor enters the wood the abdomen descends, the distended membrane gradually subsides, and the halves of the sheath make larger and larger loops above the abdomen. In withdrawing the ovipositor the reverse action takes place, and

the loops of the sheath gradually become smaller and smaller, the ovipositor proper is again forced back into the tough bladder-like membrane between the sixth and seventh joints dorsally, and there is a repetition of the appearance already described.

The specimen exhibited was captured with some others at Flatbush, Long Island, on the 8th of June instant, ovipositing in the languishing portion of a Red Maple tree extending about four feet above the surface of the ground. The ovipositor was nearly withdrawn from the wood, and the membrane was distended in a thin translucent disc fully three fourths of an inch in diameter. The insect died in the cyanide bottle before the membrane was entirely retracted, and the disc remained as now seen, about five-eighths of an inch in diameter. The specimen shows the curious fact, contrary to the published descriptions, that in this case at least the bases of the halves of the sheath, together with the base of the ovipositor proper, are forced back into the distended membrane, and that the specimen died and has remained with all these parts in this position.

On the 2d of June a German laborer named Schoeffer, a robust, healthy man, part of whose duties consisted in the care of the grounds where the Maple tree is situated, was passing the place, when he was surprised to see one of these "Long-Stings" suddenly descend and strike him upon the bare arm about three inches above the wrist. The blow felt like the prick of a pin. The insect was brushed off and arose among the foliage. Presently the affected spot itched severely and was scratched with the finger nail, when a small blister appeared, which in turn was opened with a pocket knife. Nothing more was thought of the occurrence, but that night Schoeffer walked the floor, being unable to sleep on account of violent pains shooting up the affected arm. The attendance of a physician was sought, and for four or five days intense pain, great swelling involving the entire arm, the axilla, and a portion of the side of the body, gave symptoms of a severe case of erysipelas. On the 8th of June he was seen at the office of his physician, having the arm dressed. The swelling was much reduced, and the affected spot was an open sore in the summit of a protuberance measuring about one and one-half by three inches, and discharging copiously. No theories or arguments, however able or subtle, concerning con-

taminated finger nails and knife blades will ever avail to weaken the conviction of Schoeffer that the sting of the curious insect alone was the occasion of a very close call for the loss of his arm and perhaps for the loss of his life.

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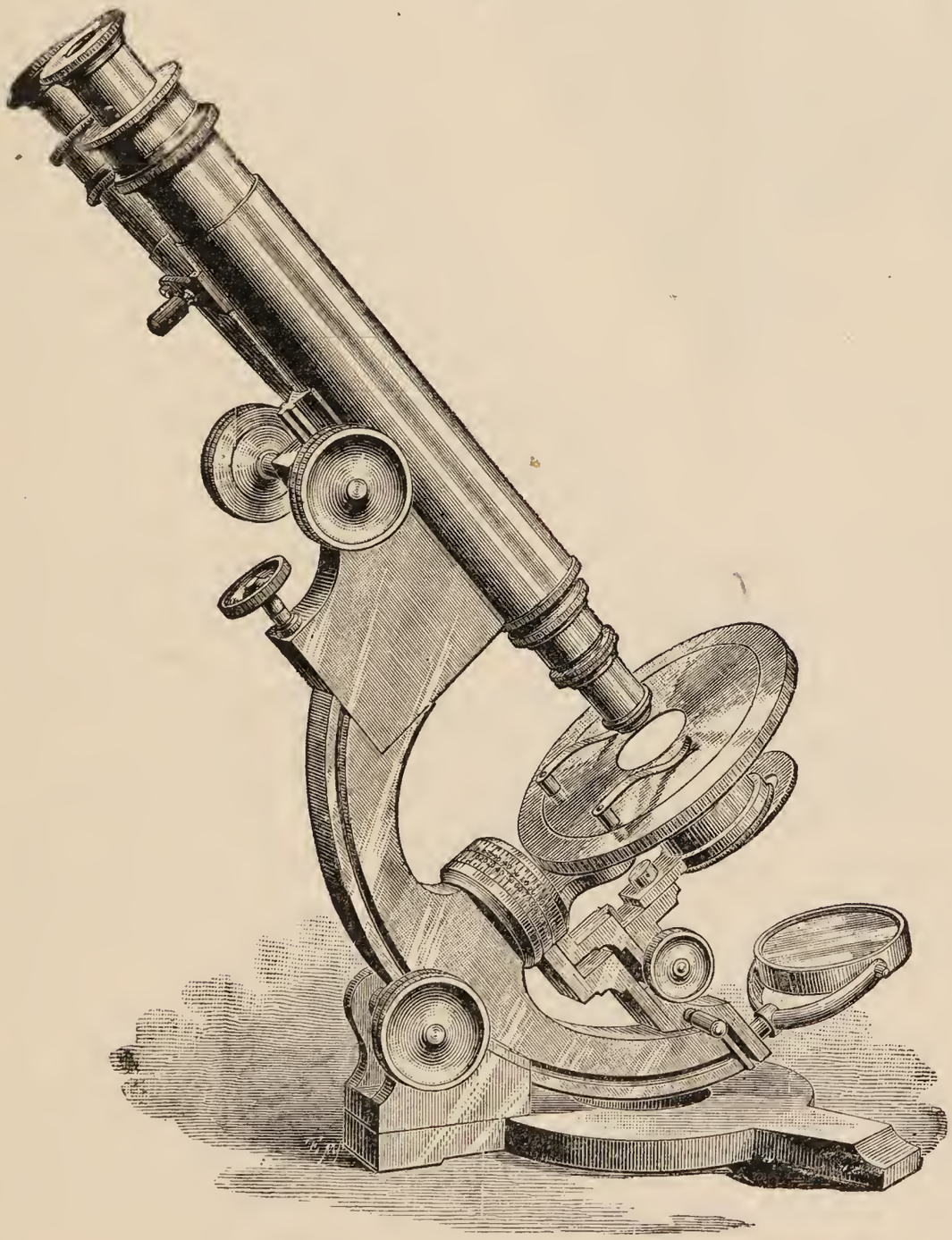

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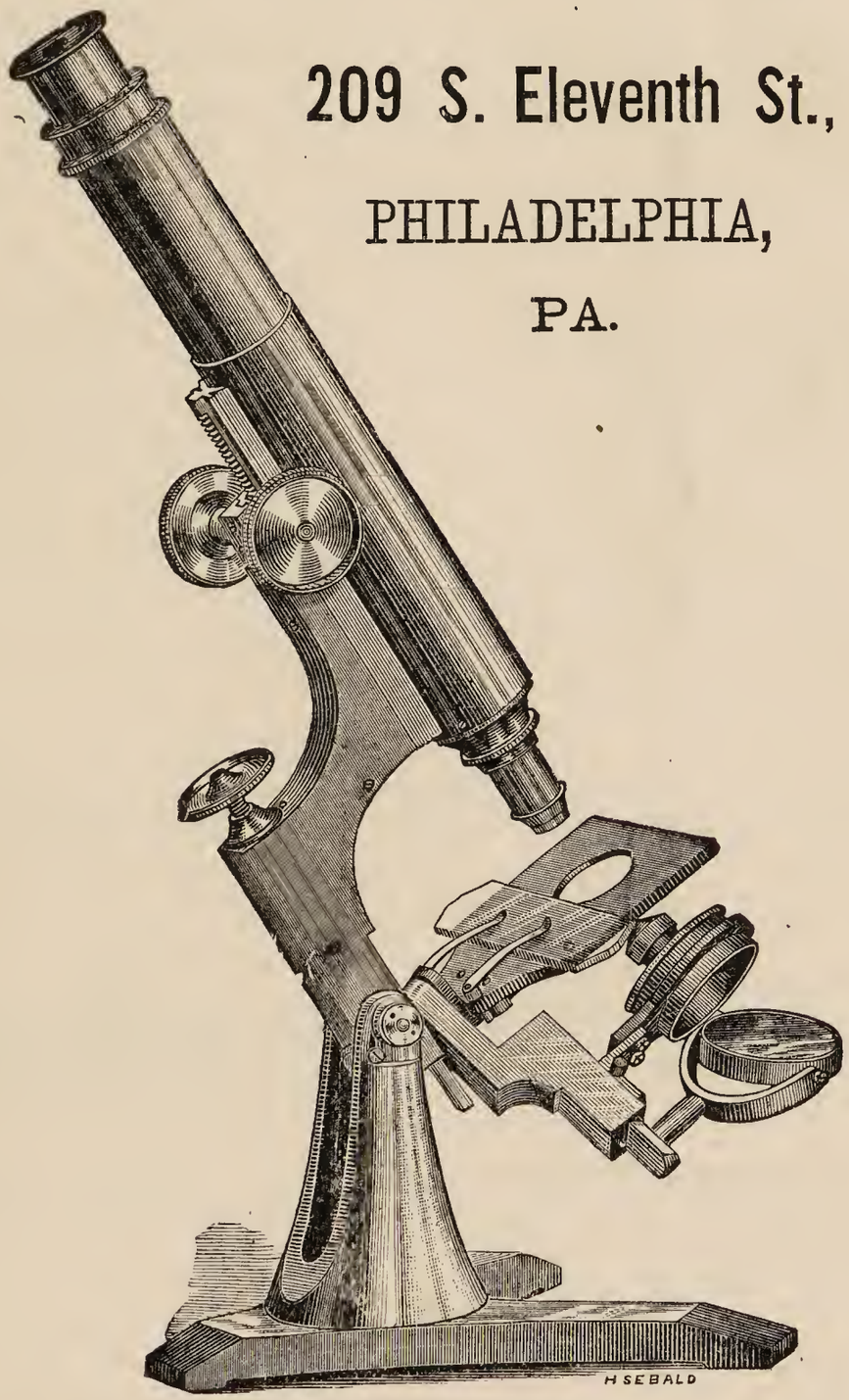

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